The Business Cycle in the Japanese Economy 1971-94: A Kaleckian View*

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[*Abstract*]

This paper constructs a Kalecki type Kaldorian model to examine features of the Japanese business cycle and a number of stylized facts. The model aims to explain the changes in the macro-economic variables associated with the business cycle. The model is tested by simulation to reproduce the observed statistical properties of the economy. The model is successful in reproducing the trend element in the key variables and is moderately successful in reproducing the dynamic path. The model is successful in mimicking the cyclical pattern of productivity and real wages, but is less successful in the cases of the labour share, the profit rate and the mark-up rate.

1. INTRODUCTION

It is well known that Kaldor's (1955-56) model of income distribution was based on a full employment economy. The model was incomplete in an underemployment economy. One way of generalizing the model to allow for underemployment is to introduce a price setting equation based on a Kaleckian idea of a full cost principle based on Iyoda (1997), which we here call a *Kalecki type Kaldorian* model (hereafter *KK* model). The essential feature of this model is in the spirit of Kaldor's model in which investment, treated as an exogenous variable, plays a strategic factor in determining the distributive shares of income. The model shows the share of profits, the rate of capital on profits, and the real wage rate as functions of investment. Our present purpose is to extend this *KK* model for an empirical analysis of the Japanese economy, and to assess the properties of the model in the context of the stylized facts.

Kalecki (1965) originally developed his theory of income distribution based on price formation at an industry level. The theory is fully explained in Feiwel (1975). However, recent studies by Lee (1994, 1995) examine various strands of nonorthodox economics—Kaleckians, post-Keynesians, Sraffians, Classicals—and he develops an empirically grounded model based

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on the business enterprise pricing equation and the empirical properties of the prices. These papers were the subject of heated discussions thereafter among post-Keynesians.[1)]

In the next section, we present a *KK* model and also outline the stylized facts. In section 3, we discuss two kinds of questions for building an empirical model. We first deal with the government and the external factors to extend the model. Next we deal with the question of 'model and reality' in relation to various prices in the market, revising two functions in the model. Section 4 examines the empirical properties of the model. The model simulates the observed statistical properties of the economy by a series of random shocks to real investment. The full empirical model is discussed in the Appendix. Finally we have a brief conclusion.

2. KALECKI TYPE KALDORIAN (*KK*) MODEL: AN APPLIED MODEL

Kaldor's original model of income distribution is expressed as:

$$\frac{P}{Y}=\frac{1}{s_p-s_w}\frac{I}{Y}-\frac{s_w}{s_p-s_w}$$

where P is profits, Y is output, and I is investment. Given the wage-earners' (s_w) and the capitalists' (s_p) propensities to save, the share of profits in income (P/Y) depends simply on the ratio of investment to output (I/Y). Kaldor assumes the 'Keynesian' hypothesis that investment, or rather, the ratio of investment to output, can be treated as an independent variable, invariant with respect to changes in the two savings propensities s_p and s_w.

The model has a solution under full employment. However, output Y is not given in an underemployment economy. Even if investment, I, is treated as an independent variable under this economy, the model is incomplete, for it has two unknowns (P and Y). The primary aim of Kaldor's model was to explain the relative stability of the distributive shares in the full employment economy. Hence, the model does not need an equation that determines the volume of employment or the volume of output in an underemployment economy. Establishing a model of income distribution in such an economy is needed to explain the change of the distributive shares and some other related variables in the various phases of the business cycle.

One of the ways taken by some Keynesians[2)] to complete the model is to introduce "the first postulate of the classical theory of employment" (Keynes, 1936, p. 5), which means that the wage rate is determined by the marginal productivity of labour. However, this is not in the spirit of Kaldor (1955-56). In keeping with Kaldor's approach we introduce a mark-up pricing equation, which we might call a 'mark-up pricing' approach. We present an applied model based on this approach.[3)]

Iyoda (1997) examined the economies of the UK, the USA, and Japan for the period 1970-92.

1) In connection with Lee's papers (1994, 1995), four papers—Lavoie (1996), Downward and Reynolds (1996), Setterfield (1996), and Lee (1996)—appeared in the same issue of the *Review of Political Economy*.

2) Sen (1963) makes an interesting comparison between Neo-classical and Neo-Keynesian theories of distribution.

3) Iyoda (1997) also presents another type of Kaldorian model by introducing an equation in which the volume of the labour force employed is determined by the volume of investment. We might call this an 'employment decision' approach (Ch. 4, Model A). See also Iyoda and Matthews (1997).

The following five stylized facts were established:

First, there was no common feature on whether the labour share moves counter cyclically or procyclically in the business cycle. However, the labour share increased in the first year of contraction and decreased in the first year of expansion, though there were some exceptions.[4]

Second, the profit rate moved procyclically to the business cycle. However, the cyclical change of the profit rate did not always coincide with the trough or peak years in the business cycle.

Third, labour productivity moved procyclically. In particular, a symmetrical change in productivity growth in the phase of the business cycle was observed: Productivity (the labour productivity per person employed) increased sharply in the first year of expansion in terms of the growth rate, and decreased in the first year of contraction.

Fourth the real wage rate had no common feature; however, its symmetrical change in the face of the business cycle, which was similar to productivity growth, was clear in the USA.[5]

Lastly, the two measures of labour shares (with and without Labour Income from Self-employment (*LIS*)) were almost parallel except for Japan and their movements were also similar, though they moved differently for some years. These similar movements held true for the two kinds of estimate of the real wage rate (between the estimates with and without *LIS*).[6]

The assumptions and notations of the model are outlined below.

(i) A closed private economy.

(ii) One product (or an aggregate product based on national income) is assumed.

(iii) The amount of capital stock and the number of workers are given in the short run.

(iv) A price is set by marking up on wages and depreciation at a customary rate, supposing that this price is generally realized on a macro level.

(v) Increase in labour force employed causes the growth of labour productivity in an underemployment economy, and a decrease of investment causes a decline in labour

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4) This pattern is strongly supported by the longer observation (Iyoda, 1987) for Japan (1955-1985) and (Iyoda, 1985) for the U.K. (1955-1982), respectively.

5) Dore (1993, pp. 19-21) presents 10 stylized facts for twentieth-century business cycles, especially those observed in market economies after World War II. His stylized facts regarding productivity and profits mostly correspond with our stylized facts. However, his stylized fact that "(3) procyclical real wages indicating that the wage share out of national income is also procyclical" is arguable.

Real wages are procyclical in the USA, but is less clear cut in the UK. For Japan, the results are in between the USA and the UK. The estimate calculated by

$$\frac{\textit{Income from Employment (IE)}}{\textit{Employees in Employment (EE)}}$$

is more similar to that of USA, but the growth rate is stable in the 1980s. For further details, see Iyoda (1997, Ch. 2, Figs. 2.11, 2.12, & 2.13, and Table 2.3). For a further argument on the real wages, see Iyoda (1997, Ch. 2, n. 26), and Greenwald and Stiglitz (1988).

6) Iyoda (1997) tries to explain these facts by his two types of Kaldorian model, finding an interpretative value of both types. He also dealt with the New Keynesian model and the Real Business Cycle models; however, these models were weak in explaining the facts. They were less concerned about explaining the stylized facts in the business cycle, and had a difficulty in explaining the change of variables in the labour market, particularly the relative share of labour and productivity (see Ch. 4 for a further argument).

productivity.[7]

We follow the notation of Kaldor(1955-56), but refer to variables in both nominal and gross terms.[8]

Y = output　　W = wages (including salaries)

P = profits　　I = investment

S = savings　　D = depreciation

L = labour force employed　　K = volume of capital

ω_m = money wage rate　　μ = labour productivity per head

r = mark-up rate　　δ = rate of depreciation of capital

L_{fk} = labour force employed under full employment of capital

s_p and s_w = propensity to save from profits and wages, respectively

To complete the model we introduce a price setting equation that corresponds to assumption *(iv)* above. We also introduce an equation based on assumption *(v)* that an increase in employment results in higher growth in labour productivity in an underemployment economy, and a decrease in investment results in a reverse case. The equation takes into consideration the facts that the productivity shows a sharp increase in the first year of expansion, and a relative decrease (or a negative growth) in the first year of contraction.

The model consists of the following equations:

(1)	$Y \equiv W + P$	Distribution of Output
(2)	$I \equiv S$	Savings-Investment Equilibrium
(3)	$S \equiv s_w W + s_p P$	Total Savings
(4)	$Y = (1 + r)(W + D)$	Price Setting Equation
(5)	$\mu = c + hL$	Productivity-Employment Function
(6)	$Y \equiv e\mu L$	Total Output
(7)	$W \equiv \omega_m L$	Wages Paid
(8)	$D \equiv e\delta K$	Depreciation (Capital Consumption)

Equations (1)-(3) are identities that are the same as those in Kaldor (we also assume simple saving functions $S_w = s_w W$ & $S_p = s_p P$). Equations (6)-(8) are identities.

Equations (4) and (5) need further explanation. Equation (4) is based on assumption *(iv)*, which means that entrepreneurs set a price by marking up on wages plus depreciation at a customary rate of r. We might call this price equation a Kaleckian type or a full cost principle type.[9] Equation (5) is based on assumption *(v)*. In an underemployment economy, the increase

7) Our assumption *(v)* is supported by some of Dore's stylized facts in the business cycle (1993, pp. 20-22). This assumption corresponds to a "procyclical relationship between labour productivity and output," and "procyclical nature of investment in fixed capital and inventories."

8) For nominal terms, we do not use "the classical dichotomy" (Patinkin, 1956), aiming at dealing with the effect of the money wage rate on other macroeconomic variables. For an argument on this matter, see Mankiw (1989); Iyoda (1997, p. 114). For gross terms, an estimation of depreciation, under the economy of high technical progress and rapid inflation, is difficult, which means that an accurate division of gross profits between depreciation and net profits is difficult to ascertain. Also for the gross terms, at the corporate level, the replacement is usually combined with new investment and the prices of capital goods are subject to changes.

9) Kalecki (1965, p. 18) himself differentiates his theory from the so called full-cost theory, on the grounds that "The degree of monopoly *may*, but need not necessarily, increase as a result of a rise in

of employment causes the growth of labour productivity until the full employment of capital,[10] and the decrease of employment causes negative or slow growth in productivity. However, it is not necessary to consider literally full employment of capital in physical terms. We consider this a normal operation rate of capital (or as the turning point below which the result would be a decrease of labour productivity). However, in reality because of growing technical progress, an absolute decrease in μ is rarely observed.

Then we have

$$\mu = c + hL$$

where $\mu' > 0$ for $L \leq L_{fk}$,

$\mu' \leq 0$ (without technical progress) for $L > L_{fk}$, and

$\mu' \geq 0$ or $\mu' < 0$ (with technical progress) for $L > L_{fk}$. $(\mu' = d\mu/dt)$

We now examine a model consisting of equations (1)-(8).

Suppose that Kaldor's treatment (*i. e.* the Keynesian hypothesis), I as an independent variable is accepted, and the other eight variables shown below are given, the number of unknown variables is equal to eight. We then have eight equations, so that the model has a solution. The relationship is articulated as follows:

1 independent variable	I
8 exogenous variables	s_w, s_p, r, ω_m, c, h, δ, and K
8 unknown variables	Y, W, P, S, L, μ, e, and D
8 equations (including identities)	(1)-(8)

The model is subject to the following two restrictions:

(i) All variables are non-negative.

(ii) $0 \leq s_w < s_p \leq 1$.

This model has a similarity to Kaldor's. By using equations (1)-(3), we have Kaldor's equation to explain the relative share of property, ρ_c:

$$\rho_c = \frac{I}{Y(s_p - s_w)} - \frac{s_w}{s_p - s_w}.$$

However, it is different from Kaldor in the following: (i) Variables are expressed in both nominal and gross terms; (ii) In the case of an underemployment economy, functions (4) and (5) are added to complete the model.

By an analysis in comparative statics, Iyoda(1997)[11] examined the effect of changes of investment, I, and money wage rate, ω_m, on the relative share of property (ρ_c), the real wage rate (ω), and the profit rate (π), respectively. As a result, it turned out that the model had the properties of the procyclical movements in both the profit rate and the real wage rate, and the property of the counter cyclical movement of the relative share of property, *i. e.* the

overheads in relation to prime costs," and stresses "the emphasis on the influence of prices of other firms." Our analysis is not made on an industry but on the whole economy. Equation (4) is based on Kalecki's idea or "the full cost principle" (Hall & Hitch 1939, p. 12), but this is not the same with each of their original ideas.

10) We observe in an actual economy, that the workforce employed increases until the peak of the business cycle and that productivity also grows until that time (see Iyoda, 1997, Ch. 2, Figs. 2.8a, 2.9a & 2.10a).

11) See Ch. 4, Model B.

TABLE 1 STYLIZED FACTS AND *KK* MODEL

	Stylized Facts	*KK* Model
Relative share of labour (ρ_l)	rather counter cyclical (ambiguous)	procyclical
Profit rate (π)	procyclical	procyclical
Productivity (μ)	procyclical (growth)	procyclical
Real wage rate (ω)	rather procyclical (ambiguous)	procyclical

Note : See Iyoda (1997) Ch. 2, Stylized Facts and Ch. 4, Model B for the detail, respectively. In this table the properties of the stylized facts are stated in a less strict way, in particular ρ_l and ω.

procyclical movement in the relative share of labour. The procyclical movement in productivity growth derives directly from assumption *(v)*.

Table 1 shows a rough comparison between the stylized facts and the properties of this *KK* model. One of the sharp contrasts is that the model has a procyclical property of the relative share of labour against its counter cyclical nature in the stylized facts.[12] Remaining properties in π, μ, and ω largely correspond to the stylized facts. Iyoda considered that, under the limited condition, the model had a possibility in explaining most of the stylized facts. However, given the simplicity of the model and its short run nature, it should be analysed further.

3. SOME REAL WORLD ISSUES

When applying the simple closed economy model to reality, the following questions must be considered.

First is a mark-up rate, r. From equations (1) and (4) above, we have

(a) $$r=(P-D)/(W+D),$$

in which r is defined in the net terms (for depreciation is deducted in the numerator). By the same equations (1) and (4), we have profits, P,

(b) $$P=D+r(W+D),$$

where P is defined in the gross terms. Since profits are defined in the broad sense, we redefine this r as

(a1) $$r=P/(W+D)$$

in the same gross terms. Then we have

(b1) $$P=r(W+D).$$

Hence we have

(4a) $$Y=W+P=W+r(W+D)$$

or $$Y=(1+r)(W+D)-D.$$

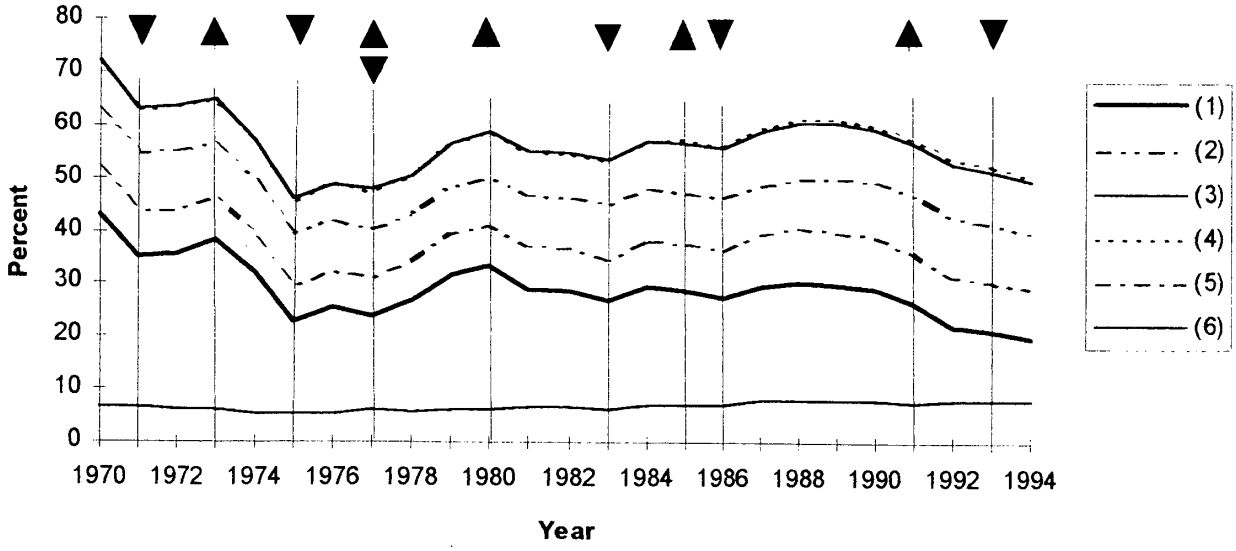
Second, we consider the government factor, introducing 'indirect taxes less subsidies' (T). Then equation (4a) becomes

(4a1) $$Y_d=W+r(W+D)+T$$

where $Y_d=GDP$, and $T=$indirect taxes less subsidies. Y_d is defined as

12) After surveying empirical studies on relative shares, King and Regan (1976, p. 18) conclude that "the EC [employee compensation] share fluctuates counter-cyclically, while the shares of both corporate profits and total profits move in the opposite direction." They continue on that "It is probably also true that these patterns apply to the labour and property shares," and "This aspect of the problem, however, has been studied less often."

Figure 1 Mark-up rates based on different definitions



Note: Trough and peak years in the Japanese business cycle by Composite Indexes (the quarter is given in parentheses). Trough and peak years are shown by inverted triangle and triangle symbols, respectively.

Trough years	1971(QIV)	Peak years	1973(QIV)
	1975(QI)		1977(QI)
	1977(QIV)		1980(QI)
	1983(QI)		1985(QII)
	1986(QIV)		1991(QI)
	1993(QIV)		

Definition: (1) $=\{P_d$(domestic profits)$-T$(indirect taxes less subsidies)$-D$(depreciation)$+Adj$(stock valuation adjustment less statistical discrepancies)$\}/\{W$(wages)$+D\}$

(2) $=(P_d-T+Adj)/(W+D)$

(3) $=(P_d+Adj)/(W+D)$

(4) $=(P+Adj)/(W+D)$

(5) $=(P_d-D+Adj)/(W+D)$

(6) $=T/(W+P_d-T+Adj)$, where $GDP=W+P_d$.

Definition (2) corresponds to the mark-up rate of our *KK* model (see Appendix A, A-1).

Source: Economic Planning Agency, *Annual Report on Business Cycle Indicators*, Ministry of Finance Printing Bureau, Tokyo.

(6a) $$Y_d \equiv e_d \mu L$$

where $e_d = GDP$ deflator.

Third we consider the external factor that includes net factor income from overseas. However, net wage income from overseas, W_o, has been negligible in Japan.[13] We do not deal with this as a separate part, considering that W includes W_o.

Then, instead of Equation (4a1) we have:

(4a2) $$Y=W+r(W+D)+P_o+T$$

where $Y=GNP$, and P_o =net property income from overseas (external profits). We accordingly define P as

13) The percentages of net wage income from overseas in our estimated whole wages were only in between 0.12 and −0.06 for the period 1970-94 (as measured by data in Appendix B).

(9) $$P \equiv P_d + P_o$$

where P_d = domestic profits.

Turning to the issue of the mark-up rate, figure 1 shows the rate based on various definitions. We here define five kinds of mark-up rates for calculation on the whole economy (see the note to the figure for the definition). These mark-up rates move rather procyclically and in parallel. This means that the selection of definition among these cases does not seem to make any large difference in the direction of change in the mark-up rate.

A modern economy is a mixture of competitive market and non-competitive and restricted markets, which means that the pricing rule is not unique. In this regard, we consider the market for goods and services supplied by both the private and the public sectors.[14]

The private sector market is broadly divided into two categories. In the case of an oligopolistic market, we assume a mark-up pricing based on normal average total costs, and denote this mark-up rate as r^*. The price is cost-determined and does not change frequently.[15] If the rate of capacity operation is above the normal rate, an actual mark-up rate, r, would be higher than r^*. In an underemployment economy, the rate of increase in capacity operation causes productivity to increase or unit cost to decrease. On the other hand, if the rate of capacity operation is below the normal rate, the actual mark-up rate would be lower than r^*. Therefore an upturn in the business cycle has an increasing r, and *vice versa* in a recession. This suggests a procyclical movement of the estimated mark-up rate. The speed (or frequency) of a price change depends on the degree of the cost increase, in particular wages. A whole product of this market (Y_1) in value added is expressed as

(4a3) $$\begin{aligned} Y_1 &= r_1^*(W_1 + D_1 + M_1) + W_1 + T_1 \\ &= r_1^*(W_1 + D_1) + W_1 + T_1 + r_1^* M_1 \end{aligned}$$

where subscript 1 denotes the value of oligopolistic market, and M = material cost (which is deducted in value added). For the time being, we neglect the external factor, which will be considered later.

In the case of a competitive market, we assume a demand-determined price. This is not a mark-up price, but for our analytical purpose we consider a pseudo mark-up rate in this submarket. An upturn in the business cycle is under the firm (strong) market, so it may be possible to assume that the pseudo mark-up rate is increasing; *vice versa* in the recession. We consider, in this respect, that the pseudo mark-up rate also tends to move procyclically. The speed of the price change depends on the degree of the change in demand. A whole product of this market (Y_2) in value added is expressed as

(4a4) $$Y_2 = r_2^*(W_2 + D_2) + W_2 + T_2 + r_2^* M_2$$

where subscript 2 denotes the competitive market, and r_2^* = mean value of the pseudo mark

14) Kalecki (1965, p. 11) classifies short-term price changes in an industry into broad groups: 'cost-determined' and 'demand-determined' prices.

15) Lee (1994, pp. 315-319) surveys a large number of research for the United States of America, and the data supplied by the Central Statistical Office and various case studies for the United Kingdom. Then he recognizes that the prices of manufactured products remain unchanged for extended period. He mentions that "it can generally be concluded that a significant proportion of industrial and consumer products in a capitalist economy, as indicated in Table 6, have prices which are based on mark-up, normal cost, and target rate of return pricing procedures" (p. 319).

up rate in this sub-market.

With the public sector, the price of goods and services produced lies in-between the competitive and the oligopolistic prices. A government controlled price is considered to be similar to an oligopolistic type (that is a cost-determined price).[16] The speed of the price changes basically depends on the change in costs, but the price changes lag behind their cost changes by the policy judgement of the day. A whole product of this market (Y_3) in value added is expressed as

(4a5) $$Y_3 = r_3^*(W_3 + D_3) + W_3 + T_3 + r_3^* M_3$$

where subscript 3 denotes this sub-market, and r_3^* is the mark-up rate based on normal average total costs in this market.

We consider an actual price in the model is a mixture of these prices.[17] A whole product consisting of these three sub-markets is written as

(4a6) $$\Sigma Y_i = \Sigma r_i^*(W_i + D_i) + \Sigma(W_i + T_i) + \Sigma r_i^* M_i$$

where $i = 1, 2, 3$. The material cost does not enter directly into national income that is a total of value added. For this cost is cancelled out among industries on the whole economy base. Then $\Sigma M_i \approx 0$. We here assume that the value of

$$\Sigma r_i^* M_i$$

is negligible.[18] Hence we have

(4a7) $$\Sigma Y_i \approx \Sigma\{r_i^*(W_i + D_i) + W_i + T_i\}.$$

Considering the external factor,

(4a8) $$Y = \Sigma Y_i + P_o \approx \Sigma\{r_i^*(W_i + D_i) + W_i + T_i\} + P_o.$$

We consider our equation (4a2) as a proxy for this (4a8).

If equation (4a2) reflects these prices, the mark-up rate is an aggregate that moves procyclically. To a lesser extent, the procyclical movement of the mark-up rate is true of the public goods and services supplied by the public sector. Considering this fluctuating mark-up rate in a broader measure, we can not deal with the mark-up rate as given.[19]

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16) After examining several studies regarding the U.K., Lee (1994, p. 322) says "in the case of government determining the market price, the costing and pricing procedures used are the same as used by private business enterprises" (see also Lee (1995) that is Part II (appendices) of his (1994)). That is a markup pricing based on costing procedures.

17) These prices reflect the modern mixed economy composed of two sectors. We decomposed this mixed economy into two sectors and made a further division into the oligopolistic and the competitive sub-sectors for the private sector. The theoretical analysis on these sectors can be made; however, an application of this model to an actual economy is hard to make. In particular we have a difficulty to assess the weight of the competitive market. Iyoda (1978) is a private two-sector extension of Iyoda (1976), the latter of which is the same as the model that excludes equations (5) and (8) in section 2. The following is our practical solution on this question.

18) This is an assumption; however, the mark-up rates may differ ($r_1^* \neq r_2^* \neq r_3^*$), but we leave this question for future research.

19) Kalecki (1965, p. 18) argues that "there is a tendency for the degree of monopoly to rise in the slump, [and] a tendency which is reversed in the boom." Contrary to this Kalecki's argument, Harrod (1936, pp. 86-87) argues that the degree of monopoly increases in the boom and falls in the slump, because the elasticity of demand diminishes in the slump and *vice versa* in the boom. Robinson (1951, p. 59) criticizes this Harrod's explanation. See also Feiwel (1975, pp. 107-108) for this argument. Mind that, however, Kalecki seems to suggest a counter cyclical movement in the relative shares of wages and

We here propose two revised functions that correspond to our reasoning based on the estimated values. One is a mark-up rate equation, and the other is a productivity-employment equation.

Our mark-up rate is defined by the broad measure and adjusted for stock valuation less statistical discrepancies. Our present analysis is not for industries but for the whole economy. The mark-up pricing (of the oligopolistic price) is based on normal average total cost that is calculated at the normal rate of capacity operation, and the mark-up rate is expressed as r^*. Actual mark-up rates fluctuate around this r^*. The pseudo mark-up rate of the competitive price also fluctuates procyclically, depending on the degree of the change of demand. That was our assumption on the pseudo mark-up rate. The prices of public goods are an oligopolistic type, though they are sometimes distorted by the political factor. We consider that the mark-up rate in the broad measure reflects the operating rate of capacity and the change of demand.

We consider the following mark-up rate function:

(4b) $$r=a+b(Y/Y^*)$$

where Y^*=capacity GNP.[20]

We put restrictions on the productivity-employment equation (5), which is divided into two cases (without technical progress and with technical progress). However, our estimated labour productivity had an increasing trend and was procyclical. In particular, a symmetrical change in productivity growth in the phase of the business cycle is observed.[21] This means our modern economy faces increasing returns, which, we consider, is important.

To express these phenomena, we consider our productivity equation in a difference form, adding a trend element. The difference form will make it possible to deal with the change of the growth rate in productivity, and the trend element expresses an increasing trend in productivity. We assume the following equation:

(5a) $$\Delta\mu=\alpha L-\lambda\mu+d+t$$

where α, λ, & $d>0$ and t=trend term. $(0<\lambda<1)$

Our extended and revised model is now composed of 10 equations. Equation (4) is replaced by equation (4a2) that includes the government and the external factors. Corresponding to this treatment, we add equation (9) to the model that defines the composition of profits. We have one more equation (4b) in relation to the mark-up rate. Finally, we replace equation (5) by (5a) that is a behavioural function.

(1) $$Y\equiv W+P$$

(2) $$I\equiv S$$

(3) $$S\equiv s_w W+s_p P$$

(4a2) $$Y=r(W+D)+W+P_o+T$$

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salaries. He considers that "Salaries, because of their 'overhead' character, are likely to fall less during the depression and to rise less during the boom than wages. Thus the 'real' wage and salary bill, V, can be expected to fluctuate less during the course of the cycle than the 'real' gross income of the private sector, Y." (p. 40)

20) We use the operating rate in manufacturing industries as a proxy for the whole economy, obtaining the capacity GNP, Y^*, by $Y^*=Y/O_r$ where O_r=operating rate in manufacturing industries. We here deal with this operating rate as a given variable.

21) See Iyoda (1997, Ch. 2, Fig. 2.8a, 2.9a & 2.10a and Tables 2.2 & 2.4).

(4b) $$r = a + b(Y/Y^*)$$

(5a) $$\Delta\mu = \alpha L - \lambda\mu + d + t$$

(6) $$Y \equiv e\mu L$$

(7) $$W \equiv \omega_m L$$

(8) $$D \equiv e\delta K$$

(9) $$P \equiv P_d + P_o$$

The model consists of 10 equations with 10 unknown variables.[22] The relationship is articulated as follows:

1 independent variable	I
14 exogenous variables	s_w, s_p, P_o, T, a, b, Y^*, α, λ, d, t, ω_m, δ, and K
10 unknown variables	Y, W, P, S, L, r, μ, e, D, and P_d
10 equations (including identities)	(1)-(3), (4a2), (4b), (5a), and (6)-(9)

4. SIMULATION

This section follows the methodological procedure of the Real Business Cycle (*RBC*) literature.[23] The model simulates the observed statistical properties of the economy by a series of random shocks to real investment. The theoretical model treats real investment as exogenous. Following the work of Nelson and Plosser (1982) the log of real investment is modelled as random walk with drift.[24] Unlike the usual practice in the *RBC* approach we make no assumption about the autoregressive structure of the random shocks. The shocks to real investment are treated as random with variance defined by historical experience. The dynamics to the model are produced by equations (4b) and (5a).

Some statistical properties of the Japanese economy in the context of the model are highlighted in Table 2 Panel A and Table 3 Panel A. The period begins in 1971 and ends in 1994. Table 2 Panel A shows the mean, standard deviation, autocorrelation coefficient and correlation with real growth for real growth ($\Delta log(Y/e)$), employment growth ($\Delta logL$) and productivity growth ($\Delta log\mu$). Table 3 Panel A shows the cross correlation between real *GNP*, the mark-up rate (r), productivity (μ), profit rate (π), real wage (ω) and labour share (ρ_l).

Panel B of Tables 2 and 3 contain the statistics produced by simulation on the empirical model. The model is successful in reproducing the trend element in the key variables and is moderately successful in reproducing the dynamic path. It is less successful in reproducing the volatility of output, employment, and productivity which raises doubts about the empirical validity of equation (5a). However, Panel B of Table 3 paints a more positive picture of the ability of the model to capture reality. The sign and magnitude of the cross-correlations are by and large reproduced. Differences occur typically only in the case of low correlations.

We now turn to an assessment of the model's ability to deal with the '*stylized facts*.' The turning points generated by the model simulations were examined along with the rest of the generated variables. Table 3 also shows procyclical productivity, which corresponds to the

22) See Appendix A for a full empirical model.

23) See Plosser (1989) for a description.

24) The unit root was confirmed by the *ADF* statistic of −3.98. The standard deviation of the growth of real investment over this period was .041.

TABLE 2

Variable	*Mean*	*Standard Deviation*	*First order autocorrelation*	*Correlation with real GNP*
Panel A		**Actual**		
$\Delta \log(Y/e)$	.038	.021	.729	1.000
$\Delta \log L$	.010	.007	.747	0.575
$\Delta \log \mu$	.028	.018	.847	0.948
Panel B		**Predicted**		
$\Delta \log(Y/e)$	.039	.060	.666	1.000
$\Delta \log L$	.008	.026	.727	0.930
$\Delta \log \mu$	.031	.037	.707	0.967

Note : The values of Panel B are based on ten simulations.

TABLE 3

Panel A			**Actual**		
$\log(Y/e)$	1.000				
γ	−.308	1.000			
μ	.999	−.295	1.000		
π	−.733	.780	−.714	1.000	
ω	.986	−.444	.984	−.801	1.000
ρ_l	−.115	−.899	−.132	−.526	.035
Panel B			**Predicted**		
$\log(Y/e)$	1.000				
γ	−.155	1.000			
μ	.992	−.197	1.000		
π	−.581	.787	−.587	1.000	
ω	.953	−.368	.972	−.715	1.000
ρ_l	.063	−.923	.087	−.777	.279

Note : See the note to Table 2.

stylized facts, and procyclical real wages, which largely correspond to the facts of the USA and Japan rather than the established fact (see footnote 5 for the circumstances). However, the cross correlation between real output, profit rate, labour share, and mark-up rate shows rather opposite results, though their values are very low except for the profit rate.[25] We consider this is largely caused by the difference of properties of the variable. Output, productivity and real wages are generally on the increasing trend, so correlation analysis in terms of *level* may be applicable to these. But profit rate, labour share, and mark-up rate fluctuate more or less, eventually centring on expected level in each case. Therefore the cross correlation between output and these variables will be analyzed properly in terms of *increment* or *growth rate.* Tables 4a, 4b and 4c set out our findings.

25) Profit rates in early 1970s are fairly high and gradually decrease with fluctuations (*e.g.* highest 30.9% in 1971, mean 18.8%, and lowest 12.9% in 1994). This general background affected to the negative correlation. Mind that actual mark-up rates were not argued in Iyoda (1997), but we here deal with this r as rather procyclical (see Figure 1). See Iyoda (1999, 2000, 2001) for further theoretical and empirical arguments of the mark-up rate. He deals with three advanced countries (the USA, Japan and the UK) during the period from 1970 to 1998, trying to demonstrate its procyclical property.

TABLE 4a
CORRELATION MATRIX (ACTUAL)

	$\Delta log(Y/e)$	Δr	$\Delta \pi$
$\Delta log(Y/e)$	1.000		
Δr	0.461	1.000	
$\Delta \pi$	0.405	0.928	1.000
$\Delta \rho_l$	−0.468	−0.988	−0.918

TABLE 4b
SIMULATED RESULTS : COMPARED WITH THE STYLIZED FACTS

Variable / No. of observations	*Number of the cyclical peak and trough in variable*					
	π		ρ_l		r	
	No.	*%*	*No.*	*%*	*No.*	*%*
Peak years 48	*Positive*		*Negative*		*Positive*	
P(−1)	10	20.8%	7	14.6%	6	12.5%
P(0)	12(7)	25.0(14.6)	14(8)	29.2(16.7)	16(8)	33.3(16.7)
P(1)	15	31.3	13	27.1	16	33.3
Others	4	8.3	6	12.5	2	4.2
Trough years 48	*Negative*		*Positive*		*Negative*	
T(0)	9(9)	18.8(18.8)	7(12)	14.6(25.0)	9(8)	18.8(16.7)
T(1)	9(14)	18.8(29.2)	10(9)	20.8(18.8)	14(8)	29.2(16.7)
Others	7	14.6	10	20.8	9	18.8
Total of P & T 96	*Expected*		*Expected*		*Expected*	
P(−1)	10	10.4	7	7.3	6	6.3
P(0) + T(0)	21(16)	21.9(16.7)	21(20)	21.9(20.8)	25(16)	26.0(16.7)
P(1) + T(1)	24(14)	25.0(14.6)	23(9)	24.0(9.4)	30(8)	31.3(8.3)
	Unexpected		*Unexpected*		*Unexpected*	
Others	11	11.5	16	16.7	11	11.5

Note : *P(−1)*, *P(0)* and *P(1)* mean a preceding, corresponding and following year of the business cycle peak, respectively. No. and % show the cyclical peak or trough that corresponds to the respective *P*. Those in parentheses for *P(0)* show the case that the result is expected but the peak or trough does not fall on any of *P(0)* and *P(1)*. Unexpected results are counted in Others. Those in parentheses for *T(0)* show the case that the result is expected but the peak or trough does not fall on any of *T(0)* and *T(1)*. Those in parentheses for *T(1)* show the case that the result is expected in *T(1)* and the following year(s) but the peak or trough does not fall on *T(1)*.

Table 4a shows correlation matrix (actual). In this Table $\Delta \pi$ and Δr are procyclical to $\Delta log(Y/e)$, and $\Delta \rho_l$ is counter cyclical to that of output, corresponding to the stylized facts. Table 4b shows, under the broader possibilities, whether or not the variable moves in the expected direction of the stylized facts. π and r are procyclical and ρ_l is counter cyclical, each of which is expected with more than 80% possibilities around these peak and trough years. Table 4c shows the simulated results of the variable to see the symmetrical change between the first expansion and contraction years in the business cycle. The symmetry is shown in productivity and to a lesser extent in real wages. Profit rate, labour share, and mark-up rate do not show symmetrical changes, but these changes are all in the similar magnitude as expected. The model performance is poor in particular in the first expansion year after trough. Probably this is partly caused by the high cross correlation between real wages and productivity (see Table 3).

TABLE 4c
SIMULATED RESULTS : COMPARED WITH THE STYLIZED FACTS

Variable / No. of observations	π *Expected*	ρ_l *Expected*	ω *Expected*	μ *Expected*	γ *Expected*
The first contraction	dec. 24	inc. 22	dec. 44(28)	dec. 48(28)	dec. 23
year 48	50.0%	45.8%	91.7%(58.3)	100%(58.3)	47.9%
The first expansion	inc. 17	dec. 17	inc. 27(47)	inc. 30(48)	inc. 17
year 48	35.4%	35.4%	56.3%(97.9)	62.5%(100)	35.4%
Total 96	41	39	71(75)	78(76)	40
	42.7%	40.6%	74.0%(78.1)	81.3%(79.2)	41.7%

Note : Dec. and inc. denote decrease and increase respectively, and observed numbers follow. On counting the number of observations, the average growth rate of ω and μ are deducted as the growth trend, respectively, but in parentheses are not. Percentages are shown as the number of observations per subtotal or total. Simulations were run 10 times, so the total years of observation are 240. The cyclical peak and trough are simply observed by the year preceding negative (or very low) growth of simulated real *GNP* and the year preceding positive (or higher) growth, respectively.

Considering Tables 3 and 4 together, productivity growth is procyclical and shows a symmetrical change in the face of the business cycle. To a lesser extent, this is true for real wages. Productivity growth follows the stylized fact and real wages follow the facts of the USA and Japan. It is less true of the profit rate and the mark-up rate, both of which largely move procyclically as in the stylized facts. The same is true for the labour share, which seems to move counter cyclically but symmetrical changes are not clear cut. In this respect the model does not mimic all the stylized facts. It may be true to say that the movements of the profit rate, mark-up rate and labour share are closely related to that of real wages, but our model lacks a money wage function (money wages are dealt as given).

5. CONCLUSION

Our purpose was to extend a *KK* model for an empirical analysis of the Japanese economy (1971-94), and to assess the properties of the model in the context of the stylized facts. For this we firstly considered the government and the external factors in the model. Secondly we introduced a mark-up rate function and a productivity-employment function to correspond to our reasoning based on estimated values. The mark-up rate seems to show cyclical movements, and productivity growth has an increasing trend and is procyclical. We conducted simulation of the model to mimic the observed statistical properties of the economy by a series of random shocks to real investment.

The results of simulation and our conclusions are:

(1) The model is successful in reproducing the trend element in the key variables and is moderately successful in reproducing the dynamic path. It is less successful in reproducing the volatility of output, employment, and productivity which raises doubts about the empirical validity of equation (5a).

(2) The model is successful in mimicking the stylized facts in the case of productivity growth and the facts of the USA and Japan in the case of real wages. It is less successful in the cases of the labour share, the profit rate and mark-up rate, in particular symmetrical changes are

not clear cut. One reason for this may be due to the fact that we have treated money wages as given.

(3) Future research will have to deal with above weaknesses in the spirit of the Kaleckian approach. Productivity equation is *ad hoc* and requires further analysis. Money wages should be dealt as endogenous along the post-Keynesian developments in monetary theory.

APPENDIX A EMPIRICAL MODEL

A-1. Data Regarding Unknown and Independent Variables

Our extended and revised model is composed of 10 equations, among which four unknown variables (Y, S, e, and D) are obtained as a time series sample from the National Accounts. By imputation of the self-employed income between wages and profits, we have Labour Income from the Self-employed (LIS). Then we have W ($=IE$ (income from employment)$+LIS$), and P as a residual ($Y-W$). Domestic profits, P_d, is obtained by ($P-P_o$), where external profits, P_o, are obtained as a time series sample from the National Accounts.

We obtain a mark-up rate, r. By equations (1) and (4a2), we have

$$W+P=W+r(W+D)+P_o+T.$$

Using equation (9), we have

$$r(W+D)=P_d-T$$

so that

(a2) $$r=(P_d-T)/(W+D).$$

In obtaining the propensity to save out of profits, we consider an Adj factor (see note 26 for this). Then, applying the same adjustment to the mark-up rate, we have

(a3) $$r=(P_d-T+Adj)/(W+D).$$

This corresponds to the second mark-up rate (2) in Figure 1. We obtain the mark-up rate from formula (a3). Productivity, μ, is calculated by $\mu=Y/eL$ (where L is obtained from the Labourforce Survey). Independent variable, I, is also obtained from the National Accounts. We now have all 10 unknown variables and one independent variable.

A-2. Exogenous Variables

First, we obtain two propensities to save, s_w and s_p. The first term, s_w, is calculated as the average of Net Savings as a proportion of disposable income on worker's household. The next term, s_p, is gained by (*Total Savings* $-s_wW$) divided by ($GNPM-W+Adj$[26]).

Second, external profits, P_o, and indirect taxes less subsidies, T, are obtained from the National Accounts, respectively. Third, the values of a and b are obtained by linear regression on equation (4b).[27]

(4b1) $$r_t=-0.303+0.828(Y_t/Y_t^*)$$

where subscript t=time period. Y^* is calculated by Y/O_r where O_r is a measure of capacity utilization in Manufacturing and is obtained from the Indices of Industrial Production.

Fourth, we propose a revised form of the productivity-employment function (5a) for an empirical model. This regression equation is

$$\Delta \ln \mu_t=d+\alpha \Delta \ln L_t-\lambda \ln \mu_{t-1}+t+\varepsilon_t$$

where ε=error term. Estimating this equation, we obtained the values of d, α, λ, and t.[28]

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26) Adj denotes (stock valuation less statistical discrepancies). For the s_p estimate we adjust $GNPM$ for this Adj factor that, we consider, might have caused some bias on the profit side; in particular for the years that these figures are enormous under the high rate of inflation in Japan.

27) We had significant results: t-values of a and b are -4.500 and 11.602, respectively and $\overline{R}$-squared is 0.8477. A dynamic version of equation (4b) was estimated:

$$r_t=-0.103+0.631(Y_t/Y_t^*)-0.277(Y_{t-1}/Y_{t-1}^*)+0.508r_{t-1}.$$

28) The estimated equation is:

$$\Delta \ln \mu_t=2.068+1.470\,\Delta \ln L_t-0.352 \ln \mu_{t-1}+0.009t \qquad \overline{R}^2=0.6432$$

(5a) $$\Delta \ln \mu_t = 2.068 + 1.470\,\Delta \ln L_t - 0.352 \ln \mu_{t-1} + 0.009t,$$

which implies a trend rate of growth of productivity of 2.6% per year.

Fifth, the money wage rate, ω_m, is defined as average earnings, W/L.

Sixth regarding equation (8), we need to find the rate of depreciation (δ) and the volume of capital (K), respectively. The depreciation rate is here defined as

(8a) $$\delta_t = D_t / K_{ft-1}$$

where K_f=net fixed capital stock. We take this K_f as a proxy for eK

$$e_t K_t = K_{ft-1},$$

then we have

(8b) $$K_t = K_{ft-1} / e_t.$$

Mind K_{ft-1} is a year-end value deducted by reconciliation account of the capital stock (RK_{ft-1}), so the beginning value in the following year is ($K_{ft-1} + RK_{ft-1}$). Net fixed capital stock, K_f, and its reconciliation account, RK_f, are obtained from the National Accounts.

A-3. Model

We defined δ by equation (8a) and made an approximate form (equation (8b)) for K in the previous section. We now have 12 equations (subscript t is omitted where it does not produce ambiguity):

(1) $$Y \equiv W + P$$

(2) $$I \equiv S$$

(3) $$S \equiv s_w W + s_p P$$

(4a2) $$Y = r(W + D) + W + P_o + T$$

(4b1) $$r_t = -0.303 + 0.828(Y_t / Y_t^*)$$

(5a) $$\Delta \ln \mu_t = 2.068 + 1.470\,\Delta \ln L_t - 0.352 \ln \mu_{t-1} + 0.009t$$

(6) $$e \equiv Y / \mu L$$

(7) $$\omega_m \equiv W / L$$

(8) $$D \equiv e\delta K$$

(8a) $$\delta_t \equiv D_t / K_{ft-1}$$

(8b) $$K_t = K_{ft-1} / e_t$$

(9) $$P \equiv P_d + P_o$$

We treat, I, at current prices and I_c at constant prices, both of which are given as exogenous. Gross domestic fixed capital formation (I_f) at constant prices is obtained by deducting the external surplus and stock increase (including stock appreciation) from I_c. We have:

(10) $$I_{fc} = I_c - EX$$

where EX is the stock increase and external surplus, and I_{fc} is I_f at constant prices. Net fixed capital stock, K_f, is obtained as follows:

(11) $$K_{ft} = K_{ft-1} + RK_{ft-1} + I_{fct} \cdot e_{ft} - \delta_t K_{ft-1}$$

where RK_f=reconciliation account of K_f, and e_f=implicit price deflator of I_f.

To this we add three identities for analytical purposes: the relative share of labour ρ_l, the profit rate π, and the real wage rate ω.

(12) $$\rho_l \equiv W / (Y + Adj)$$

(13) $$\pi \equiv (P - T + Adj) / (K_{ft-1} + RK_{ft-1})$$

(14) $$\omega \equiv \omega_m / e$$

Thus we have an empirical model that consists of 17 equations.

APPENDIX B DATA

B-1. *Data Source Abbreviation*

(3.842) (3.739) (−3.757) (3.072) $D.W.$=2.0640

for sample period 1971-94; 't' values are in parentheses.

AFS Annual Report on the Family Income and Expenditure Survey, Statistics Bureau of Management Coordination Agency.
ANA Annual Report on National Accounts, Economic Planning Agency (EPA).
DS Datastream.
RNA Report on National Accounts from 1955 to 1969, EPA.
RRNA Report on Revised National Accounts on the basis of 1980, EPA.

B-2. *Data*
(1) National Accounts
GNPM (*GNP* at Market Prices), *GNPC* (*GNP* at Constant Prices), I (Gross Investment including External Surplus at Market Prices), I_c (I at Constant Prices), I_{fm} (Gross Fixed Capital Formation at Market Prices), I_{fc} (I_f at Constant Prices), e (*GNP* Deflator), and e_f (Implicit Price Deflator of I_f):
DS for 1970(1969)-94 (data obtained as of August 1995).
D (Depreciation obtained by I_{fm} less Net Fixed Capital Formation (*NFCF*)):
I_{fm} from *DS* (see above), and
NFCF from Part 2, I.2 *ANA* 1993, 1995 for 1970-93 (see (4) below for *NFCF* (1994)).
T (Indirect Taxes less Subsidies):
Part 1, [2] IV.2 *ANA* 1995 for 1970-92; *ANA* 1996 for 1993-94.
P_o (Net Property Income from Overseas) and W_o (Net Wage Income from Overseas):
Part 1, [2] T19 (Vol.1) *RRNA* (1986) for 1970-83, and
Part 1, [2] T19 *ANA* 1990, 1996 for 1983-94.
Adj. (Stock Valuation Adjustment and Statistical Discrepancies):
(Stock Valuation Adjustment)
Part 4, [3] T18 (Vol.2) *RRNA* (1986) for 1970-80, and
Part 1, [3] T18 *ANA* 1988, 1993, 1995 for 1981-93; *ANA* 1996 for 1994.
(Statistical Discrepancies)
Part 1, [2] I.1 (Vol.1) *RRNA* (1986) for 1970-80, and
Part 1, [2] I.1 *ANA* 1988, 1993, 1995 for 1981-93; *ANA* 1996 for 1994.

(2) Stock
K_f (Net Fixed Capital Stock), RK_f (Reconciliation Account of K_f), K_i (Increase in Stocks), and RK_i (Reconciliation Account of K_i):
Part 4, I.1-3 *RNA* (1988) for 1969, and
Part 2, I.1-3 *ANA* 1995 for 1970-93; *ANA* 1996 for RK_f (1993-94) (see (4) for K_f (1994) and K_i (1994)).

(3) Others
W (Wages), *IE* (Income from Employment), *LIS* (Labour Income from the Self-employed), and P (Profits):
Iyoda(1997) Ch. 2, The Labour Share (p. 7) for *LIS*, W and P (1970-92, all at Market Prices) where *LIS* is imputed by using an asset basis. These figures are extended to 1993 by the respective recent version of the data. The *LIS* formula is defined as:
LIS = *IS*(Income from the Self-employed) − (Profits of Incorporated Enterprises) × (Gross Capital Stock Ratio of Unincorporated to Incorporated Enterprises).
(See (4) for W (1994) and P (1994)).
CPI (Consumer Price Index), L (Workforce in Employment), and O_r (Operating Rate in Manufacturing Industries):
DS for 1970(1969)-94.
Net Savings and Disposable Income for s_w:
Major Figures on Family Budget (Workers Household), *AFS* 1991, 1994 for 1970-94.
Total Savings for s_p:

Total Savings $= I$ (see above for I).

(4) 1994 Values for K_f, K_i, *NFCF*, W, and P

The base year of national accounts was changed from 1985 to 1990 in 1996 edition of *ANA*. Most of the time series values are affected by this change, and unfortunately it is now impossible to get 1994 values on the basis of 1985. Iyoda and Matthews (1997) used national accounts data on the basis of 1985. For the convenience of comparison, this paper mostly shares the data with those in our previous paper (1997), with one year extending and two series of data adding (P_o and W_o). For K_f, K_i, *NFCF*, and Distribution of National Income values for calculating W and P, we adjusted 1994 values by the three-year-average of the ratio of Old Value (on the basis of 1985) to New Value (on the basis of 1990) for 1991-1993:

3 year-average × 1994 New Value.

K_f deducted by RK_f is obtained by K_f in 1993 (on the basis of 1985) plus *NFCF* in 1994. These adjustments are made by using the respective table in *ANA* 1995 and 1996 above. We consider that, though our adjustment is simple, this will be better than using non-adjusted values.

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